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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/039,196	01/02/2002	Robert J. Falster	MEMC 00-1400(2806.1)	7221
321	7590	03/30/2004	EXAMINER	
SENNIGER POWERS LEAVITT AND ROEDEL			RHEE, JANE J	
ONE METROPOLITAN SQUARE			ART UNIT	
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ST LOUIS, MO 63102			1772	

DATE MAILED: 03/30/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/039,196

Applicant(s)

ROBERT J. FALSTER ET AL.

Examiner

Jane J Rhee

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-59 is/are pending in the application.
- 4a) Of the above claim(s) 1-19 and 53-59 is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed..
- 6) ☒ Claim(s) 20-34 and 38-52 is/are rejected.
- 7) ☒ Claim(s) 35-37 is/are objected to.
- 8) ☒ Claim(s) 1-59 are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on ____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on ____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. ____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) ____.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). ____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

Election/Restrictions

Restriction to one of the following inventions is required under 35 U.S.C. 121:

- I. Claims 1-19, drawn to a process, classified in class 117, subclass 13.
- II. Claims 20-52, drawn to an article, classified in class 428, subclass 64.1.
- III. Claims 53-59, drawn to a method, classified in class 438, subclass 14.

The inventions are distinct, each from the other because of the following reasons:

Inventions I and II are related as process of making and product made. The inventions are distinct if either or both of the following can be shown: (1) that the process as claimed can be used to make other and materially different product or (2) that the product as claimed can be made by another and materially different process (MPEP § 806.05(f)). In the instant case the product can be made by another and materially different process such as controlling a growth velocity without an average axial temperature gradient.

Inventions I and III are unrelated. Inventions are unrelated if it can be shown that they are not disclosed as capable of use together and they have different modes of operation, different functions, or different effects (MPEP § 806.04, MPEP § 808.01). In the instant case the different inventions are unrelated because the process is for growing single crystal silicon ingot and the method is of evaluating gate oxide integrity of a population of single crystal silicon wafers wherein the process is making a crystal silicon ingot and the method is determining dielectric characteristics of a silicon wafer.

The silicon ingot of the process is not used in the method of determining dielectric characteristics of a silicon wafer; also the process is used to create the silicon ingot while the method is used to evaluate the gate oxide integrity of a population of a single crystal silicon wafer.

Inventions II and III are related as product and process of use. The inventions can be shown to be distinct if either or both of the following can be shown: (1) the process for using the product as claimed can be practiced with another materially different product or (2) the product as claimed can be used in a materially different process of using that product (MPEP § 806.05(h)). In the instant case the product can be used in a materially different process of using the product such as a substrate in a deposition process.

Because these inventions are distinct for the reasons given above and have acquired a separate status in the art as shown by their different classification, restriction for examination purposes as indicated is proper.

During a telephone conversation with Mr. Hejlek on March 4, 2004 a provisional election was made with traverse to prosecute the invention of Group II, claims 20-52. Affirmation of this election must be made by applicant in replying to this Office action. Claims 1-19, 53-59 withdrawn from further consideration by the examiner, 37 CFR 1.142(b), as being drawn to a non-elected invention.

Applicant is reminded that upon the cancellation of claims to a non-elected invention, the inventorship must be amended in compliance with 37 CFR 1.48(b) if one or more of the currently named inventors is no longer an inventor of at least one claim

remaining in the application. Any amendment of inventorship must be accompanied by a request under 37 CFR 1.48(b) and by the fee required under 37 CFR 1.17(i).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 20-29,42 are rejected under 35 U.S.C. 103(a) as being unpatentable over Falster et al. (WO 98/45507) in view of Park (6485807).

Falster et al. discloses a single crystal silicon wafer comprising a front surface, a back surface, a lateral surface joining the front and back surfaces, a central axis perpendicular to the front and back surfaces (page 4 lines 7-12), and a segment which is axially symmetric about the central axis extending substantially from the front surface to the back surface in which crystal lattice vacancies are the predominant intrinsic point defect (page 4 lines 28-30), the segment having a radial width of at least about 40% of the radius (page 5 line 3) which is within the range of applicant's claimed at least about 25% of the radius, and containing agglomerated vacancy defects (page 10 line 14), and a residual concentration of crystal lattice vacancies (page 4 lines 28-29, figure 14 number 80), wherein the residual concentration of crystal lattice vacancy intrinsic point defects is less than the threshold concentration at which uncontrolled oxygen precipitation occurs upon subjecting the wafer to an oxygen precipitation heat treatment

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(page 5 lines 18-27, this passage states that the wafer will contain oxygen precipitates having a concentration profile which the peak density of the precipitates in the bulk layer is at or near the central plane with the concentration of the precipitates in the bulk layer generally decreasing in the direction of the front surface layer, meaning that the oxygen precipitation is controlled therefore the residual concentration of crystal lattice vacancy intrinsic point defects is inherently low). Falster et al. discloses that the wafer is capable of having a concentration of oxygen precipitates of less than $1 \times 10^8 \text{ cm}^{-3}$ (page 20 line 24). Falster et al. discloses that the wafer has a nominal diameter of at least 200mm (page 51 line 4). Falster et al. discloses that the segment has a width of 100% (page 25 lines 21-22, the vacancy dominated region may extend from center to edge which is 100% of the radius) which encompasses applicant's claimed width of at least 50-95%. Falster et al. discloses that the carbon concentration is less than $1 \times 10^{16} \text{ atoms/cm}^3$ (page 14 line 26-27).

Falster et al. fail to disclose that the agglomerated vacancy defects have a radius of less than about 70-30nm. Park teaches that in order to reduce the size of voids in the ingot which is desirable according to embodiments of the present invention, the cooling rate of the ingot may be increased (col. 18 line 44-46).

Therefore, since applicant discloses in figure 19 that the void radius is smaller at a faster cooling rate, it would have been obvious to one having ordinary skill in the art at the time applicant's invention was made to provide that the agglomerated vacancy defects have a radius of less than about 70-30nm, since it has been held that

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discovering an optimum value of a result effective variable involves only routine skill in the art. *In re Boesch*, 617 F.2d 272, 205 USPQ 215, (CCPA 1980).

The wafer being subjected a rapid thermal anneal in which the wafer is rapidly heated to a temperature of 1200 degrees Celsius in the essential absence of oxygen and then cooled and then subjected to an oxygen precipitation heat treatment, consisting essentially of annealing the wafer at 800 degrees Celsius for 4 hours and then at 1000 degrees Celsius for 16 hours is a process limitation, process limitations are given little or no patentable weight. The method of forming the product is not germane to the issue of patentability of the product itself. Further, when the prior art discloses a product which reasonably appears to be either identical with or only slightly different than a product claim in a product-by-process claim, the burden is on the Applicant to present evidence from which the Examiner could reasonably conclude that the claimed product differs in kind from those of the prior art. *In re Brown*, 459 F.2d 531, 173 USPQ 685 (CCPA 1972); *In re Fessman*, 489 F.2d 742, 180 USPQ 324 (CCPA 1974). This burden is NOT discharged solely because the product was derived from a process not known to the prior art. *In re Fessman*, 489 F.2d 742, 180 USPQ 324 (CCPA 1974).

3. Claims 30-34, 38-39, 45-51 are rejected under 35 U.S.C. 103(a) as being unpatentable over Falster et al. (WO 98/45507) in view of Park (6485807) and in further view of Falster et al. (US5919302).

Falster et al. '507 and Park discloses the wafer described above. Falster et al. '507 fail to disclose the average void density less than $1 \times 10^8 \text{ cm}^{-3}$, less than 5×10^7

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cm^{-3} , less than $1 \times 10^7 \text{ cm}^{-3}$, less than $5 \times 10^6 \text{ cm}^{-3}$, and greater than $5 \times 10^7 \text{ cm}^{-3}$.

3. Falster et al. '507 fail to disclose residual vacancy concentration is less than 3

$\times 10^{12} \text{ cm}^{-3}$, less than $2 \times 10^{12} \text{ cm}^{-3}$, less than $1 \times 10^{12} \text{ cm}^{-3}$, less than $5 \times$

10^{11} cm^{-3} , less than $1 \times 10^{11} \text{ cm}^{-3}$, less than $5 \times 10^{10} \text{ cm}^{-3}$, less than $1 \times$

10^{10} cm^{-3} . Falster et al. '302 teaches the density of vacancy and self-interstitial

agglomerated defects is within the range of about $1 \times 10^3/\text{cm}^3$ to about $1 \times 10^7/\text{cm}^3$

which encompasses applicants claimed average void density less than $1 \times 10^8 \text{ cm}^{-3}$,

less than $5 \times 10^7 \text{ cm}^{-3}$, less than $1 \times 10^7 \text{ cm}^{-3}$, less than $5 \times 10^6 \text{ cm}^{-3}$, and greater

than $5 \times 10^7 \text{ cm}^{-3}$ and applicant's claimed residual vacancy concentration less than 3

$\times 10^{12} \text{ cm}^{-3}$, less than $2 \times 10^{12} \text{ cm}^{-3}$, less than $1 \times 10^{12} \text{ cm}^{-3}$, less than $5 \times$

10^{11} cm^{-3} , less than $1 \times 10^{11} \text{ cm}^{-3}$, less than $5 \times 10^{10} \text{ cm}^{-3}$, less than $1 \times$

10^{10} cm^{-3} for the purpose of improving the yield factors in device fabrication

processes (col. 2 lines 13-14).

Therefore, it would have been obvious to one having ordinary skill in the art at the time applicant's invention was made to provide Falster et al. '507 with the density of vacancy and self-interstitial agglomerated defects is within the range of about $1 \times 10^3/\text{cm}^3$ to about $1 \times 10^7/\text{cm}^3$ for the purpose of improving the yield factors in device fabrication processes (col. 2 lines 13-14) as taught by Falster et al. '302.

Falster et al. '507 fail to disclose that the oxygen content is less than 13PPMA. Falster et al. '302 teaches that the oxygen content is less than 13PPMA (col. 13 line 11-12) for the purpose of avoiding enhanced oxygen clustering (col. 13 line 18-19).

Therefore, it would have been obvious to one having ordinary skill in the art at the time applicant's invention was made to provide Falster et al. '507 with an oxygen content of less than 13PPMA in order to avoid enhanced oxygen clustering (col. 13 line 18-19) taught by Falster '302.

4. Claims 40-41 are rejected under 35 U.S.C. 103(a) as being unpatentable over Falster et al. (WO 98/45507) in view of Park (6485807) and Falster et al. (US5919302) and in further view of Tamatsuka et al. (6162708).

Falster et al. '507, Park and Falster et al. '302 discloses the wafer described above. Falster '507 et al. fail to disclose the nitrogen content of less than 1×10^{13} atoms/cm³. Tamatsuka et al. teaches a nitrogen content in the range of 1×10^{10} – 5×10^{15} atoms/cm³ (col. 2 line 27) which overlaps applicants claimed range of 1×10^{13} atoms/cm³ for the purpose of accelerating oxygen precipitation therefore obtaining the epitaxial silicon single crystal wafer wherein high gettering capability can be maintained (col. 2 lines 19-23).

Therefore, it would have been obvious to one having ordinary skill in the art at the time applicant's invention was made to provide Falster et al. '507 with a nitrogen content in the range of 1×10^{10} – 5×10^{15} atoms/cm³ for the purpose of accelerating oxygen precipitation therefore obtaining the epitaxial silicon single crystal wafer wherein high gettering capability can be maintained (col. 2 lines 19-23) as taught by Tamatsuka et al.

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5. Claims 43-44,52 are rejected under 35 U.S.C. 103(a) as being unpatentable over Falster et al. (WO 98/45507) in view of Park (6485807) and in further view of Tamatsuka et al. (6162708).

Falster et al. and Park discloses the wafer described above. Falster et al. fail to disclose the nitrogen content of less than 1×10^{13} atoms/cm³. Falster et al. fail to disclose a homoepitaxial layer deposited on the front surface thereof. Tamatsuka et al. teaches a nitrogen content in the range of 1×10^{10} – 5×10^{15} atoms/cm³ (col. 2 line 27) which overlaps applicants claimed range of 1×10^{13} atoms/cm³ for the purpose of accelerating oxygen precipitation therefore obtaining the epitaxial silicon single crystal wafer wherein high gettering capability can be maintained (col. 2 lines 19-23).

Therefore, it would have been obvious to one having ordinary skill in the art at the time applicant's invention was made to provide Falster et al. '507 with a nitrogen content in the range of 1×10^{10} – 5×10^{15} atoms/cm³ for the purpose of accelerating oxygen precipitation therefore obtaining the epitaxial silicon single crystal wafer wherein high gettering capability can be maintained (col. 2 lines 19-23) as taught by Tamatsuka et al.

Tamatsuka et al. teaches an epitaxial layer formed in the surface layer portion of the resultant silicon single crystal wafer for the purpose of producing an epitaxial silicon single crystal wafer (col. 1 line 66).

Therefore, it would have been obvious to one having ordinary skill in the art at the time applicant's invention was made to provide Falster et al. '507 with a homoepitaxial layer formed in the surface layer portion of the resultant silicon single

crystal wafer for the purpose of producing a homoepitaxial silicon single crystal wafer (col. 1 line 66) as taught by Tamatsuka et al.

Allowable Subject Matter

6. Claims 35-37 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. Claims 35-37 regards to an average void density greater than $1 \times 10^7 \text{ cm}^{-3}$. Falster et al. (US5919302) teaches the density of vacancy and self-interstitial agglomerated defects is within the range of about $1 \times 10^3/\text{cm}^3$ to about $1 \times 10^7/\text{cm}^3$, teaches away of obtaining an average avoid of density greater than $1 \times 10^7 \text{ cm}^{-3}$ since the object of Falster et al. '302 is to produce a wafer with substantially free of defects resulting from an agglomeration of crystal lattice vacancies or silicon self interstitials.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jane J Rhee whose telephone number is 571-272-1499. The examiner can normally be reached on M-F.

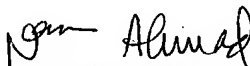
If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nasser Ahmad can be reached on 571-272-1487. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9306 for regular communications and none for After Final communications.

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Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0661.



Jane Rhee
March 8, 2004


NASSER AHMAD
PRIMARY EXAMINER